SOIL SURVEY OF ST. JOSEPH COUNTY, MICHIGAN.

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DESCRIPTION OF THE AREA.

St. Joseph County, Mich., lies along the southern boundary of the lower peninsula, approximately in latitude 42° north and longitude 85° 30′ west. It is bounded on the north by Kalamazoo County, on the east by Branch County, on the west by Cass County, and on the south by the State of Indiana. The included area is 503 square miles, or 321,920 acres.

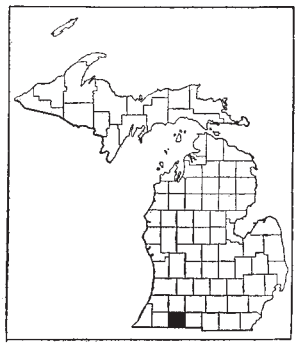

FIG. 3.—Sketch map showing location of the St. Joseph County area, Michigan.

St. Joseph County is bisected almost diagonally from the northeast to the southwest by the St. Joseph River. This makes the slope a general one toward the southwest, with the northwest part of the county sloping mainly to the southeast and south, and the southeast section draining toward the northwest and north. The Rocky River and Portage River from the north join the St. Joseph River at Three Rivers. From the south and southeast the Fawn River joins the St. Joseph at Constantine; the Prairie River enters it about 2 miles south of Three Rivers, and White Pigeon River about one-half mile north of the State line.

The topographic features of the county are quite distinct, the most striking being the vast outwash plains along the many rivers of the county. The county lies entirely within the glaciated region, and contains many areas of drift, both stratified and unstratified, as well as the outwash plains. Sherman, Flowerfield, and Fabius Townships are quite rolling, some portions being almost too rough for successful cultivation, while Sturgis, White Pigeon, and Mottville Townships consist mainly of level plains. There are, scattered throughout the county, a great many lakes ranging in size from a few acres to more than 2 square miles. The highest part of the county probably is in Fabius Township, where several hills exceed 1,000 feet elevation; the lowest point is in the southwest corner of Mottville Township, where the St. Joseph River leaves the county, at which place the elevation is about 760 feet above sea level. The average elevation of the county is somewhat more than 840 feet, which is slightly greater than the average for the State.

According to Leverett,[1] the bedrock is found at a depth of about 300 feet and is a carboniferous sandstone. Over this rock is spread

[1] Leverett, Frank. Surface Geology of Michigan. Michigan Geological Survey, Publication 25, 1917.

a cover of glacial drift which in some places is level and in other places is of hilly topography.

Figure 4 is a sketch map of the county showing the topography. The greater part of the county consists of a nearly level plain, with an elevation ranging from 780 feet to 840 feet above sea level. The morainic areas comprise gently rolling, rolling, and hilly soils. The level and gently rolling areas include the best farming lands, while the rolling areas are not so good and the hilly areas are in most places

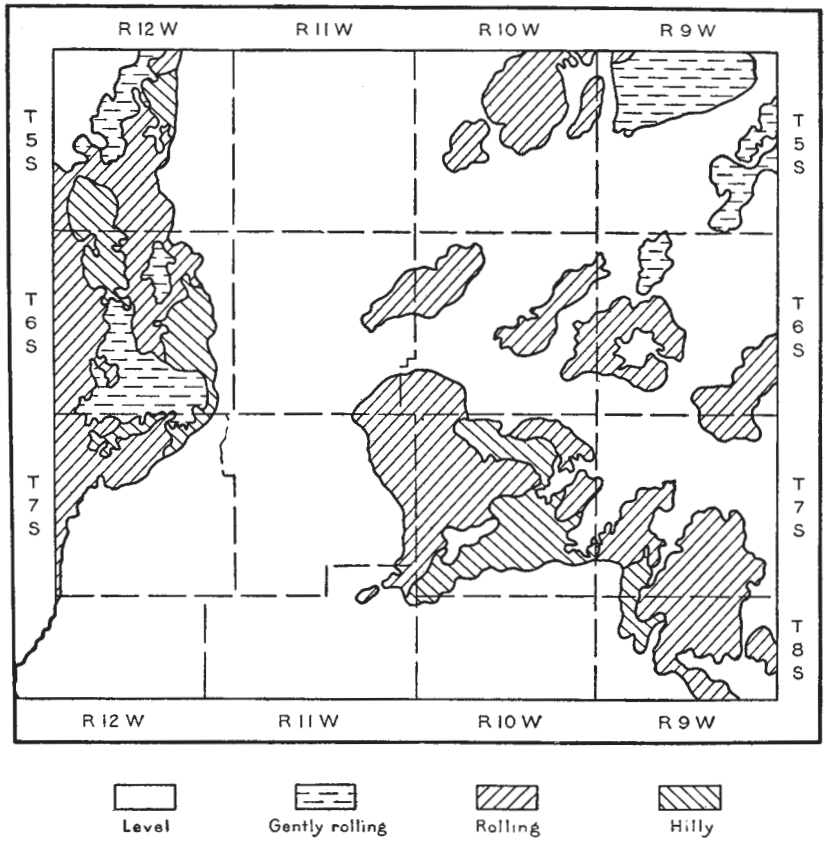

FIG. 4.—Sketch map showing physiographic divisions.

too broken for general crop production. Fruit growing, grazing, or growing of trees for wood or lumber are best suited to the hilly areas.

The hilly area on the west side of the county is the most broken, and some of the hills here reach a height of more than 1,000 feet above sea level. A small area north of Sturgis, near the center of the county, is also of quite irregular topography. The greater number of the lakes are found in the very hilly areas.

The first white settlers came into the territory now included in St. Joseph County about the year 1813, but not until the thirties did

FIG. 1.—ORIGINAL TIMBER GROWTH ON THE LEVEL OUTWASH PLAINS OF THE COUNTY. THESE SCATTERED OAK GROVES GAVE THE PIONEER NAME OF "OAK OPENINGS" TO THE FOX AND PLAINFIELD SOILS.

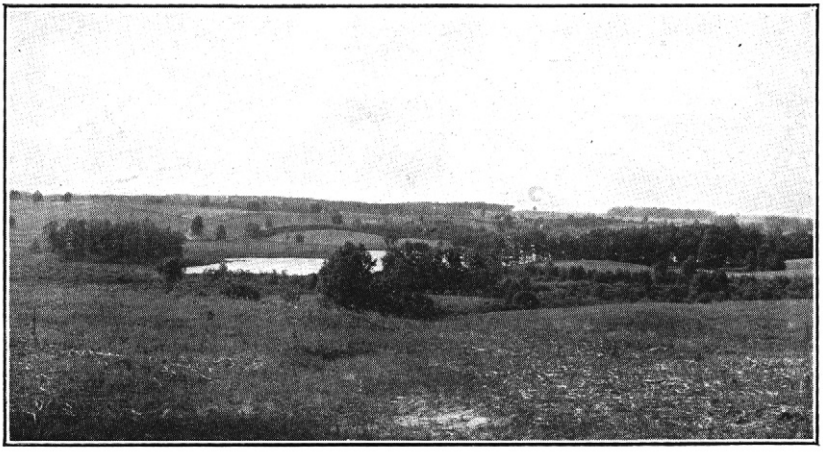

FIG. 2.—CHARACTERISTIC TOPOGRAPHY OF THE COLOMA AND BELLEFONTAINE SOILS. AT THE LEFT, NEAR THE LAKE, IS A SMALL AREA OF MUCK.

FIG. 1.—SHOWING THE GENTLY UNDULATING TOPOGRAPHY AND LUXURIANT TIMBER GROWTH CHARACTERISTIC OF THE CONOVER LOAM.

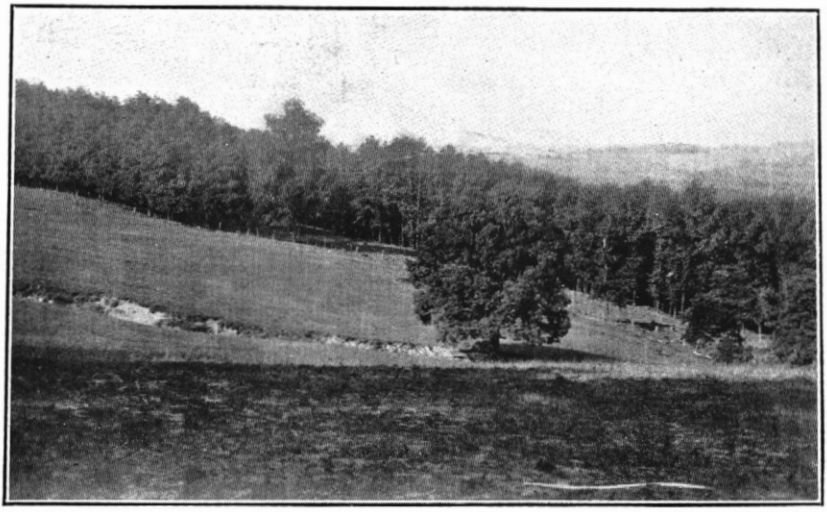

FIG. 2.—TYPICAL TOPOGRAPHY OF RODMAN SANDY LOAM. LAND OF THIS TYPE IS VALUED CHIEFLY FOR ITS FOREST AND FOR GRAZING.

settlement begin in earnest, when considerable numbers immigrated from New York, Ohio, and Pennsylvania. The county was organized in 1829 and by 1850 had a population of 12,725. The population more than doubled in the next 30 years, fell to 23,889 in 1910, and rose to 26,818 in 1920, or about 200 more than in 1880, the year of earlier maximum. The present density is 53.3 per square mile.

There are two cities in the area with a population exceeding 5,000, Sturgis being the largest, with 5,996 people, and Three Rivers second in size, with 5,219 population, according to the last census. There are many small industries in each, furniture, baby carriages, and paper being made in Sturgis and automobiles and engines in Three Rivers. Mendon, Centerville, Colon, Burr Oak, Constantine, and White Pigeon are moderate-sized villages important mainly as shipping points for farm produce, except the last-named village, which has a paper mill in which the most of its inhabitants are employed. Mottville, Howardsville, Flowerfield, Parkville, and Fawn River are small villages without railroad facilities, but serving as trading centers for their communities. Moore Park, Leonidas, Nottawa, Wasepi, and Factoryville are similar small villages with railroads. At Klinger Lake, Nottawa, and also north of Fabius station there are summer-resort colonies on the lakes. These colonies are important markets for fruits, garden truck, milk, and eggs during a large part of the summer.

The county is traversed by three railroad systems, so that it is quite accessible. The Michigan Central Railroad, Air Line Division, passes through Three Rivers, Centerville, Wasepi, and Colon and is used as a short haul for freight between Niles and Jackson. A main line of the New York Central Lines, or Lake Shore & Michigan Southern Railroad, passes through White Pigeon, Sturgis, and Burr Oak, and a branch line beginning at White Pigeon passes northward through Constantine, Moore Park, and Flowerfield Station and on to Kalamazoo. The main line of the Grand Rapids & Indiana Railway enters the county from the south and passes through Sturgis, Nottawa, Wasepi, and Mendon on its way to Kalamazoo and Grand Rapids. These railroads, with the well-developed trunk-line highways, place the county in a favorable position for the expeditious marketing of its products. Important outside markets include Chicago, 132 miles distant; Kalamazoo, 30 miles; Jackson, 65 miles; South Bend. 40 miles; and Detroit, 140 miles.

CLIMATE.

The following table, compiled from the records of the Weather Bureau station at Wasepi, which is slightly east of the center of the county, gives the salient facts concerning the climate. This station is 842 feet above sea level.

Normal monthly, seasonal, and annual temperature and precipitation at Wasepi.

[Elevation, 842 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1920).	Total amount for the wettest year (1883).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	26.4	62	−18	2.59	4.13	0.79	9.0
January	24.3	64	−19	2.80	2.40	2.39	9.7
February	21.9	63	−22	2.20	.51	7.30	11 1
Winter	24.2	64	−22	7.59	7.04	10.48	29.8
March	34.4	83	−1	3.37	3.61	.91	7.0
April	46.9	89	13	2.76	6.03	2.80	.8
May	58.2	90	25	4.79	1.72	9.26	T.
Spring	46.5	90	−1	10.92	11.36	12.97	7.8
June	66.0	96	35	3.96	2.18	7.55	.0
July	71.4	100	44	3.80	1.86	9.27	.0
August	69.2	100	40	3.35	1.39	1.60	.0
Summer	68.9	100	35	11.11	5.43	18.42	.0
September	63.3	97	28	3.00	1.78	1.68	.0
October	52.1	87	18	3.14	1.77	3.80	.2
November	39.1	73	8	2.73	2.79	7.92	3.2
Fall	51.5	97	8	8.87	6.34	13.40	3.4
Year	47.8	100	−22	38.49	30.17	55.27	41.0

The mean annual precipitation is distributed fairly evenly over the year, though the average precipitation during May, June, and July is slightly greater than for any other three months in the year. This is very important in crop production in St. Joseph County on account of the sandy nature of the soils. Even with this favorable distribution there are occasional doughts ranging in duration from four to six weeks. The average snowfall is 41 inches, which gives ample protection for fall-sown grains. Hail and wind storms are not of common occurrence.

The mean annual temperature is 47.8° F. The temperature is subject to sudden changes in the early fall and late spring. There are sometimes periods of extreme heat and cold, but these usually are not protracted. The lowest temperature recorded is −22° F. and the highest 100° F.

The length of the growing season is on an average 161 days, which is sufficient for the maturing of most crops commonly grown in this region. The average date of the first killing frost in the fall is October 14, but the earliest frost recorded occurred on September 14. In spring the average date of the last killing frost is May 5, but the records show one as late as May 22. Cattle can be pastured about nine months each year.

AGRICULTURE.

The agriculture of St. Joseph County dates from about 1825. The rich black, open prairies which required no clearing were undoubt-

edly the choice of the first settlers. The Sturgis prairie and the White Pigeon prairie show evidences of having been the homes of these pioneers. Next the "oak openings," or level outwash plains (Pl. I, Fig. 1), which constitute so large a part of the area of this county, were brought under cultivation, and finally, the rough hilly areas were settled and used for agriculture. The soils of the prairies have thus been farmed for nearly 100 years, and those of the oak openings almost as long. The soils of the hilly sections were brought under cultivation much later, because they were neither so desirably situated nor so easy to cultivate. Of the 321,920 acres of land in the county, over 303,000 acres was included in farms before 1900. Of this total, 253,827 acres was classed as improved land.

During the later part of the nineteenth century this section of Michigan was known as a great grain producing region. In many sections wheat was grown continuously for many years. This fact is important in considering the present status of agriculture in the county. In 1880 the wheat produced totaled 1,263,661 bushels, on 66,669 acres; corn 1,358,318 bushels on 35,275 acres; and oats 316,042 bushels on 9,858 acres. In the 1920 census wheat production had dropped to 388,375 bushels from 24,035 acres, while corn had increased in acreage to 1,074,445 bushels on 43,470 acres, and oats 286,397 bushels on 18,112 acres. Rye, which in 1880 was a minor crop with a production of 2,213 bushels on 157 acres, is now extensively grown, 476,579 bushels being produced on an acreage of 38,611 acres in 1919.

A very interesting fact in the agriculture of the county is brought out by comparison of the status of clover as a crop in 1880 and in 1920. In 1880 the acreage in this crop was 31,500 and the yield of hay 37,936 tons, in addition to which 9,911 bushels of clover seed was produced. In 1920 there were only 5,297 acres in clover, about one-sixth of the earlier acreage, producing 4,326 tons of clover hay—less than 1 ton per acre. This situation is becoming critical in its bearing on the future agriculture of the county. No permanent form of agriculture can exist under conditions of continuous grain growing without the ultimate use of clovers or some other legume in a rotation, unless commercial fertilizers are used freely. In order to produce alfalfa or the clovers satisfactorily the use of lime in some form is essential. In certain sections there are many farms entirely deserted, the fields being occupied by volunteer rye and weeds, quite different from the conditions there 30 or 40 years ago.

The fact that rye is becoming an important crop in the county is further evidence of the lack of a proper choice of crops during the period when the productivity of the soil was high, as is the run-down appearance of the once fine farm buildings on the oak openings. When wheat could no longer be profitably produced many farmers turned to rye as a cash crop.

The following tables give the value of the farm products and the number and value of live stock in the county, as reported by the census of 1920.

Value of all farm products, census 1920.

Product.	Value.	Product.	Value.
Cereals	$3,490,538	Live-stock products:	
Other grains and seeds	102,995	Dairy products [1]	$589,927
Hay and forage	1,105,676	Poultry and eggs	615,762
Vegetables	444,443	Honey and wax	3,294
Fruits	56,090	Wool	86,748
All other crops	22,256	Total	6,517,729

[1] Excluding home use of milk and cream.

Number and value of animals on farms and ranges, census 1920.

	Number.	Value.		Number.	Value.
Horses	8,259	$733,291	Swine	24,761	$424,888
Mules	138	13,410	Poultry	176,517	175,026
Beef cattle	3,010	180,442	Bees (hives)	881	4,582
Dairy cattle	13,608	823,482			
Sheep	21,829	239,517	Total		2,594,638

The agriculture of St. Joseph County at the present time consists of general farming, with corn, oats, wheat, rye, potatoes, and hay as the principal products. The chief cash crops are corn, wheat, rye, and potatoes. Poultry raising, vegetable growing, and dairying are important, and should be and probably will be greatly expanded in the near future. In addition to the feed crops produced, feeds worth $352,236 were purchased in 1919. On certain of the lighter textured soils, locally known as oak openings, the farmers grow corn only to provide feed and depend upon the rye and potato crops for their income. Corn does not do well on these soils; it is more successfully grown on the prairies and on the rougher beech and maple soils.

In the prevailing method of corn culture the land is manured as soon as the work of sowing oats is finished in the spring, after which it is plowed and pulverized with a spring-tooth harrow at least twice. The seed is planted between May 15 and May 30, either with a grain drill or a check-row planter. A few acres are planted with hand planters. After the corn is up some farmers go over the ground with a spike-tooth harrow or a weeder, which tends to destroy small weeds and thus conserve moisture which is quite important on the lighter soils. Corn is given three to five cultivations depending upon the season. Two-horse cultivators are largely used. The crop is harvested in most cases with a binder and either fed to cattle in the bundle or husked. Many use the crop for filling the silo, especially when the season has been rather dry for good ear production. Some fields are "hogged off." The corn is husked by hand or with a shredder.

Wheat and rye are sown in the fall on land plowed usually in August. The time of seeding ranges from September 5 to September 25, depending somewhat on the prevalence of the Hessian fly. Wheat or rye commonly follow oats in the rotation. These crops mature in the early part of July, and are often threshed in the field as cut and drawn directly to market. Oats usually follow corn and in many cases the only preparation consists of running a disk harrow and then

a spring-tooth harrow once or twice over the stubble. This is quite successful, provided the cornfield was kept free from weeds. In some cases corn stubble is given a shallow plowing. The oats are seeded as soon as the land can be properly fitted in the spring. The crop matures in August and is cut and threshed, to be used largely for feed on the farms. In some cases timothy is seeded in the fall and clover in the early spring, with one or another of the small grains. Since so many failures in getting a stand have occurred with this method, some have been sowing their clover and timothy like other spring grains, without a nurse crop. This practice is not widespread, however, nor is it entirely successful.

Up to the present time commercial fruit growing has made little progress, although nearly every farm has a sufficient supply for home use, and, in good fruit years, a surplus for the local market. According to the census the value of orchard and other fruits in 1919 was $56,090, showing this to be a secondary industry.

There is one area near the outskirts of Three Rivers where strawberries are grown extensively. The fruit is sold, but the main object is the production of plants. In this area there is one tract equipped with overhead irrigation which is a very successful enterprise.

The possibilities of extending fruit growing seem good. The soils are well adapted to fruit production and lie close to Chicago and other large markets. The opportunity for extension in the more hilly sections of the county, where the soil is usually not well suited to grain growing, appears particularly good. Heretofore successful grain production has absorbed the efforts of the farmers, but as the returns from grain crops decrease, it is probable that fruit production will increase proportionally.

There are several areas of Muck in the county that are used extensively for growing peppermint and spearmint. In establishing these crops the plants are set by hand. The first year the crop is grown in rows and cultivated, but thereafter cultivation is discontinued and in a few years the ground is entirely covered. Handling and extracting, however, require much machinery, and the necessary capital is comparatively large, so that the crop is not widely grown.

Hogs, sheep, dairy cattle, and poultry form the important live stock. Hogs, sheep, wool, and other animal products are sold locally, although some are shipped to Kalamazoo, a distance of about 25 miles. The hogs are fattened on corn or ground rye in the fall and slaughtered or sold on the hoof to shippers. Hog cholera is not prevalent. The hogs are largely of the Duroc-Jersey, Poland China, and Chester White breeds.

Dairy herds vary in size, the average herd numbering about 5 animals. The milk in some cases is shipped to cheese factories, or the cream is sold locally for shipment to ice-cream factories. Butter is made chiefly for home consumption. The herds are made up of grade Holstein, Jersey, and a few Shorthorn animals.

The sheep industry is not an extensive one, the flocks being kept mostly on farms including marshland or woodlots, which make good permanent pastures. The lambs are sold in the fall or early winter and the wool clip in the spring. The flocks include grade Shropshire and some Leicester and Merino sheep.

The farm buildings in St. Joseph County as a rule are well built, and most farms have comfortable houses and ample barn room.

There are a great many deserted farmhouses, however, in some parts of the county. The farms that are still in a fair state of production have neatly kept buildings, and it is rather saddening to see the large and originally well-built houses now shabby and deserted on account of the injudicious use of once productive land.

There is a close correlation between the soil type and the number of abandoned farms. Scarcely any houses in the hilly regions of the county or on the prairies are without tenants. The Fox and Plainfield soils are the ones upon which the greatest number of tenantless farms occur. If it be considered that declining productiveness of the land is the cause of the moving away of the tenant, then it would seem that these soils have been the first to suffer. As stated already, the prairie soils were the first to be brought under cultivation, the Fox and Plainfield soils were second, and the soils of the hilly sections were last. The prairie soils are still very productive, as are also the hill soils. So it would seem that the Fox and Plainfield soils are the least able to stand the strain of an inefficient cropping system. It has long been known, however, that the nature of the virgin soil with regard to origin and original vegetation may be of utmost importance in the consideration of the true value of the soil as a crop-producing medium over a long period of years.

Some of the farms are equipped with electric-light plants and running water. Gasoline engines are quite common and a large number of tractors are in use, especially on the more level lands. Work horses are of good quality and mostly grade Percherons and Belgians. In some cases mules are used for farm work.

The rotation practice is corn or potatoes, oats, wheat, or rye, and hay. In some sections, especially on the prairies, rye is grown year after year. Grass occupies the land from one to three years.

In 1920, about one-fifth of the farms reported the purchase of fertilizers. Evidently the use of commercial fertilizer is not thought necessary by a considerable majority of farmers. The fertilizers used most commonly have the formulas 2–12–2 or 2–12–0.[2] These are applied on growing oats and wheat, very little being used on corn. Acid phosphate alone is also used profitably on grains and as a reinforcement for barnyard manure on corn. The use of lime is growing rapidly on account of the necessity for its use in getting a stand of clover or alfalfa. From 1 to 2 tons is applied per acre.

The total expenditure for farm labor for 1919 was $332,824, with 1,278 farms reporting. The laborers are drawn mostly from the local supply, except in harvesting and threshing grain or in growing and harvesting certain special crops where some outside labor is used. At the time of the survey (1921) good hands could be obtained for $2 a day. Forty dollars a month is about the average wage for laborers hired by the month, season, or year. In the last two years the supply of labor has been satisfactory.

According to the 1920 census, the total number of farms in the county is 2,436. The farms range in size from a few acres to more than 1,200 acres, with an average size of 119.9 acres. The average of improved land per farm is 96 acres. About two-thirds of the farms are operated by the owners, 741 by tenants, and 19 by managers. Some farms are leased for cash, rents ranging from $3 to $5

[2] Formulas stated in the order nitrogen, phosphoric acid, potash.

an acre; the other tenant-operated farms, which form 93 per cent of the farms rented, are worked on shares, usually half of the proceeds.

The average value of the property on each farm in St. Joseph County is $10,692. Good farm land may be purchased on the prairies for $150 to $200 an acre and land in other sections for $75 to $150, depending on the topography, condition of land and buildings, and distance from market. The average assessed value of farm land for the county is $52.87 an acre.

St. Joseph County has probably passed its maximum of production and prosperity under the present system of farming, but with the introduction of more scientific methods it should prosper again as it did in the latter part of the nineteenth century.

SOILS.

St. Joseph County lies within the glaciated region of the United States. The drift in almost all places is formed of limestone materials with various admixtures of materials from other rocks, such as sandstone and shale. Granite bowlders also are common. On account of the open, porous structure of the lighter textured materials and the great amount of leaching that occurs in them it is not often that carbonates appear within 5 feet of the surface.

The county is a part of the watershed of the St. Joseph River, which was the outlet for great quantities of water coming from the melting glacier. Thus were developed the great outwash plains and glacial drainage belts adjacent to this river and its tributaries. The true glacial drift was deposited in moraines, which as a rule are rather rough. There are no well-developed till plains in the county, except in small areas in the northeastern part.

The Bellefontaine, Rodman, Conover, and Coloma soils are the higher lying, better drained soils of the true drift areas. They are light-colored upland series, the first three being derived from drift with a high content of limestone, the latter from light sandy material of a noncalcareous nature. The Crosby soils are also light-colored upland soils derived from calcareous drift, but in flat areas of deficient drainage.

The types in the Bellefontaine series have a brown to reddish-brown surface soil, a lighter colored, somewhat reddish-gray or reddish-yellow upper subsoil, and a reddish-brown lower subsoil, heavier than the two layers above. The substratum is a porous, calcareous gravelly till. Varying quantities of sandstone, shale, granite, and gneiss fragments occur throughout the soil section. The topography is prevailingly rolling (Pl. I, Fig. 2), and the drainage good to excessive.

The Rodman series includes types with brown to grayish-brown surface soils and a light yellowish-brown to slightly reddish subsoil. The substratum below 40 to 50 inches is highly calcareous. Drainage is excessive, and the land is in many places too broken to be of much agricultural value.

The types included in the Conover series have gray to grayish-brown soils, a light-gray mottled subsurface, a darker gray, pale-yellow, or variegated upper subsoil, heavier than the soil, streaked with iron stains and a more friable brown subsoil. Calcareous till

lies at a depth of 40 to 45 inches below the surface. The lower part of the subsoil and the substratum contain few bowlders, but considerable gravel. The surface is undulating to very gently rolling. The drainage is incomplete.

Types in the Coloma series are characterized by a brownish-gray to brown surface soil, a yellow friable subsurface layer, and a light-yellow colored subsoil and substratum which extends to an indefinite depth. Drainage is often excessive and the soils have low water-holding capacity. Carbonates are not present, since the material as originally laid down was of a light sandy nature and probably carried very little limestone material. The topography is morainic and rolling, but there are not many bowlders present.

The soils of the Crosby series are gray to light gray at the surface, light ashy gray or light gray mottled with yellow and brown in the subsurface, brown and gray mottled in the subsoil, and grayish or yellowish gray in the substratum. The soil and subsurface layer have about the same texture. The upper subsoils are heavier than the soil in texture, rather compact and tough, changing at a depth of 20 to 30 inches into more friable material, which is glacial drift partially weathered. The soils have developed under poorer drainage conditions than the Conover soils.

Materials of the level outwash plains deposits give rise to the light-colored Fox and Plainfield soils, and where calcareous and existing under prairie conditions to the dark-colored Waukesha soils.

The Fox soils are distinguished by a grayish-brown to brown, in places slightly reddish brown, surface soil with a yellowish-brown upper subsoil and a reddish-brown, tough, heavy lower subsoil, which rests upon a bed of gravel at a depth of 2½ to 5 feet below the surface. The latter is the unweathered material, mainly stratified beds of sand and gravel, highly calcareous and porous. The change in color from the reddish lower subsoil to the gray parent material is very abrupt, and the line dividing these two horizons is very irregular, being 5 feet below the surface in one place and only 3 feet below in another only a little distance away. The topography is level to undulating and the drainage is good.

The Plainfield soils closely resemble the Fox, except that they are confined to areas where the subsoil is light in texture and the underlying material is of a light sandy nature and carries little or no limestone material. Drainage in places is excessive.

The surface soil of the types included in the Waukesha series is almost black when moist and a chocolate brown when dry. The subsoil is a dull yellowish brown and the lower subsoil a light reddish brown. The parent material is gray stratified sand and gravel, carrying large quantities of limestone material. The drainage is complete to excessive. The topography is fairly smooth to gently rolling. No bowlders are found on the surface or in the soil section, but below 18 to 24 inches the subsoil is very gravelly.

Small areas of lake-laid deposits occur in the county. These have given rise to soils placed in the Maumee and Newton series.

The Maumee types have very dark gray to nearly black soils, a light-gray upper subsoil in places streaked with light brownish iron stains, and a strongly mottled with gray, drab, yellow, and brown lower subsoil, appreciably heavier in texture than the layers above. The types occupy flat basins and are naturally poorly drained. The

drab stratified sand and clay, representing the unweathered deposits, which is somewhat calcareous, is encountered at 2 to 4 feet below the surface.

The Newton soils are similar to the Maumee in topography, formation, and profile arrangement, but the surface soil is dark gray in color and the underlying material is not so strongly calcareous.

The soils derived from recent alluvial deposits have been classified in the Genesee and Wabash series.

The types included in the Genesee series have a dark-brown surface soil and a lighter brown, sometimes slightly mottled, subsoil. The topography is prevailingly level, but occasionally hummocky. Drainage is fairly good betwen overflows. The soils are derived from reworked calcareous drift.

Types included in the Wabash series have a black surface soil, a dull-brown subsurface and upper subsoil, highly mottled with drab and brown iron stains, and a white or gray, entirely deoxidized, lower subsoil. These soils are derived from water-worked calcareous drift. The drainage is poor.

In addition to the types in the series already described, there occur bodies of Muck derived from cumulose deposits.

The following table gives the name and actual and relative extent of the several types of soil developed in St. Joseph County. The distribution of the soils is shown by means of colors on the accompanying map. Detailed descriptions of each type mapped follow the table.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Fox sandy loam	106,944	33.2	Conover loam	4,992	1.6
Bellefontaine sandy loam	64,064	19.9	Newton sandy loam	3,392	1.1
Muck	44,864	13.9	Wabash loam	1,920	.6
Plainfield sandy loam	35,904	11.2	Maumee sandy loam	1,920	.6
Waukesha sandy loam	17,856	5.5	Coloma sandy loam	1,792	.5
Rodman sandy loam	15,296	4.8	Genesee loam	1,664	.5
Fox loam	7,424	2.3	Crosby loam	1,344	.4
Bellefontaine loam	7,360	2.3			
Plainfield loamy sand	5,184	1.6	Total	321,920	

BELLEFONTAINE SANDY LOAM.

The surface layer of the cultivated Bellefontaine sandy loam consists of a friable, brown or grayish-brown sandy loam, which in places is slightly tinged with red. In virgin areas there is first a 1 or 2 inch layer of forest mold, under which a reddish-brown to grayish-brown soil occurs. The subsoil layer, which begins at a depth of about 8 inches, has a lighter color, being more a reddish yellow or light brown. The texture differs little from that of the surface soil to a depth of 14 to 16 inches. The lower subsoil is considerably heavier in texture and of more compact structure than the materials above it, even becoming quite tough in places. The material is strongly reddish brown, the color being of a brighter shade than in the other layers, and there is no mottling. This layer extends from about 14 inches to a depth of 2½ feet, where it grades into a reddish-brown or brown friable loam or gravelly loam continuing to depths of 3 to 5 feet. Below this is a coarse, somewhat gravelly mass of

calcareous till, gray to yellowish gray in color, crumbly, and quite difficult to bring up with an auger. Thus there exists four distinct color changes; the surface, dark with the organic matter accumulated there; the upper subsoil, of lighter shade, somewhat yellowish; then the lower subsoil, bright reddish brown; and finally the substratum of gray unweathered till. The third layer or lower subsoil is evidently an alluvial one, since it has been shown by analysis to be the depository of the finer particles washed downward, as well as of much iron and aluminum. This horizon is of great importance in the conservation of moisture for the use of crops.

This soil, which forms 19.9 per cent of the area of the county, is found in hilly or morainic sections. The drainage is good. The original timber growth was largely maple, with some walnut, beech, hickory, and ash.

The important crops are corn, oats, wheat, rye, hay, and potatoes. Potatoes yield about 150 bushels per acre, corn 25 to 50 bushels, oats 30 to 60 bushels, wheat 15 to 30 bushels, rye 10 to 20 bushels, and hay from 1 to 2 tons. The usual methods of handling the soil are employed, except that few tractors and other heavy machinery are used, on account of the somewhat rough topography. The soil may be quite easily kept in good tilth. Few bowlders are encountered. This land, where it has been cropped for a number of years, responds to applications of lime and complete fertilizers.

Land of this type sells for $75 to $150 an acre, depending upon its topography, nearness to market, and the condition of roads.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, subsoil, and lower subsoil of the Bellefontaine sandy loam:

Mechanical analyses of Bellefontaine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
301505..	Soil, 1 to 7 inches.....	2.4	12.9	13.4	29.4	7.2	27.9	6.8
301506..	Subsurface, 7 to 12 inches.....	1.7	12.2	12.7	27.7	7.9	31.2	6.7
301507..	Subsoil, 12 to 40 inches	2.8	14.1	14.7	30.9	6.8	19.1	11.5
301508..	Lower subsoil, 40 to 60 inches.....	1.6	9.2	10.0	36.7	15.6	19.3	7.5

BELLEFONTAINE LOAM.

In the virgin condition, the upper layer of the Bellefontaine loam consists of an accumulation of leaves, twigs, and other débris from the hardwood forest which it supports. Below this layer of organic matter is a dull reddish brown surface soil. The organic layer is 1 or 2 inches thick, and the surface soil proper is about 4 to 6 inches thick. When the land is cultivated, these two layers are consolidated, the distinct organic layer disappears and the whole surface layer, 7 to 8 inches in thickness, assumes a uniform dull reddish-brown color. When the cultivated soil is wet it appears quite dark. The second layer, or what may be termed the upper subsoil, is somewhat lighter in color, being a light brown to light reddish brown, and extends to a depth of about 15 inches. Below this occurs the third

layer of bright reddish brown with no mottling or streaking of colors. This is the most striking layer of the soil on account of its thickness and reddish coloration. The depth at which this layer ends varies somewhat, being usually about 2½ feet below the surface, and then there is a zone of porous gravelly loam giving way at about 4 feet to gray or grayish-yellow, highly calcareous, unweathered till. This consists of gravel mixed with fine earth, and has a very open, porous structure, affording good drainage.

The surface and subsoil layers are rather well granulated and of almost the same texture, both being loams. The lower subsoil is rather more compact and tough, but granular when dry. It is evidently the layer of accumulation of the finer particles from above as it has the heaviest texture of the four.

In topography this soil is distinguished from the Bellefontaine sandy loam in being more level and hence more easily cultivated. Only scattered glacial bowlders are found.

The crops grown are the same as on the sandy loam, but the yields are slightly higher on the loam. Tractors, as well as other heavy machinery, may be used on this type to advantage. Lime often gives good results, but fertilizers are not always profitable. This type is probably the strongest soil in the county. It is not so droughty as the more level prairie types. The value ranges from $125 to $175 per acre.

CONOVER LOAM.

The surface soil of the Conover loam in the virgin state is a loam of dark-gray color, over which is a layer of forest mold from 1 to 2 inches thick. If cultivated, the two layers become intermingled and a brownish-gray soil layer is the result. This extends to a depth of 7 to 9 inches, where it gradually changes to a somewhat lighter colored subsoil layer, 4 to 6 inches thick. These two layers are almost alike in texture, the subsoil seeming to contain a little less fine material, though probably the surface feels finer on account of its supply of organic matter. At a depth of about 14 inches the lower subsoil begins, the change being accompanied by a bright mottling and streaking of colors; red, yellow, orange, and gray are intermingled promiscuously. The texture of this stratum is clay loam, and considerably heavier than the layers above it. At a depth of 2½ feet there appears light-brown loam and at 3½ to 5 feet a friable calcareous till. There are many bowlders throughout the soil section and on the surface. These consist mainly of granite, gneiss, and quartzite. Piles of stones are thickly distributed over some cultivated areas.

The structure of the soil is usually granular and a good tilth is not hard to maintain. The second subsoil layer is somewhat more intractable and holds water with great tenacity, which is a valuable feature during droughty periods.

This type has been formed under conditions of imperfect drainage, its topography being rather level or only slightly rolling and the streams rather sluggish. (Pl. II, Fig. 1.) The forest growth consists of hardwoods, principally beech and maple, with walnut, hickory, and ash trees rather numerous.

Corn, oats, wheat, and hay are grown. There are not many farms on this type which have resorted to rye as a cash crop as yet, nor are

potatoes grown on a large commercial scale. The farming seems to be of a general type, in which a large amount of feed is grown and fed, and the animals and their products disposed of. Corn produces from 30 to 75 bushels of grain per acre, or from 8 to 14 tons of silage. Oats yield an average of 50 bushels per acre, wheat from 20 to 35 bushels, and hay 1½ to 2 tons per acre. Unless insufficiently drained, this land is almost as productive as the Bellefontaine loam. Barnyard manure and some acid phosphate are used as fertilizers. Lime is applied only when alfalfa is to be seeded. Clover occupies a larger acreage on this soil than on any other in the county. A fair value for land of this type would be about $125 per acre.

CROSBY LOAM.

The Crosby loam, in the virgin condition, consists of 1 to 2 inches of a gray to dark brownish gray loam, grading below into a light gray loam streaked or mottled with rusty-brown iron stains and commonly carrying some small quantities of concretionary material. Under cultivation the surface soil, to a depth of 6 to 9 inches, or as deep as the land has been plowed, is brownish gray to gray, becoming light and ashy in appearance on drying. The light-gray subsurface layer extends to a depth of 12 to 15 inches, giving way below to a sticky or plastic clay loam, mottled yellowish brown, rusty brown and gray, and this grades at depths of 24 to 30 inches into a light-brownish, friable loam which extends downward to the parent rock—a gravelly and stony calcareous till. Some large bowlders are scattered over the surface and some gravel and small angular fragments of rock occur throughout the soil profile.

The Crosby loam is a type of minor importance in St. Joseph County. It occurs in the northeastern corner in association with the Conover and Bellefontaine soils, occupying flat areas and broad sags between ridges. The type has developed under deficient drainage conditions, but where the soil has not been as wet as in the areas occupied by dark gray to black soils.

Probably over 50 per cent of the type is cleared. Its chief use is for pasture, but a considerable acreage is devoted to the production of hay and some is used in growing corn, oats, and wheat. Where artificially drained the yields of the different crops grown are about as good as on the Conover loam. Corn and oats yield from 20 to 50 bushels, wheat 10 to 20 bushels, grass and clover grown separately or mixed from three-fourths to 2 tons per acre.

The position of the type is such that all of it can be adequately drained by tilling. Most areas are in need of better drainage and until this is provided the yields will be uncertain and usually unsatisfactory. The liberal use of lime will prove very beneficial.

RODMAN SANDY LOAM.

The soil of the Rodman sandy loam in virgin condition consists of a layer, one-half to 1 inch thick, of forest mold, resting on light-brown gravelly sandy loam, extending to a depth of about 6 inches. The upper subsoil is a light brown or light reddish yellow, these colors persisting to a depth of 10 to 12 inches where a bright reddish-brown layer of sand or loamy sand is encountered. This layer ex-

tends to the unweathered drift which lies at an average depth of 6 feet. The drift has a light-gray color, is very calcareous and consists in the main of stratified gravel beds. Some large bowlders occur throughout this type.

The topography is very rough and rolling (Pl. II, Fig. 2) and vertical sections through the ridges disclose underlying stratified gravel deposits.

This is a poor soil for farming, because of its unfavorable topography and coarse texture. Around the lower slopes of the hills and in depressions there has accumulated some quite fertile soil, but taken as a whole the type has a very low agricultural value under present conditions. It can be used for grazing and hay production, or perhaps for forestry, but it probably will never support a highly developed agriculture. This type exists mainly in regions where lakes are present, and some garden crops are sold to the summer resorts. This trade is of local importance only.

The price of land of this type ranges from $50 to $100 an acre, depending mainly upon its location with regard to lake resort colonies and towns, or upon its value as a source of gravel.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, subsoil, and lower subsoil of the Rodman sandy loam:

Mechanical analyses of Rodman sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
301535..	Soil, 1 to 7 inches.....	1.7	13.1	16.9	41.1	7.0	14.4	5.7
301536..	Subsurface, 7 to 15 inches.....	1.9	16.4	16.6	26.2	5.7	23.9	9.2
301537..	Subsoil, 15 to 36 inches.	3.3	15.8	17.1	36.5	8.9	9.2	9.4
301538..	Lower subsoil, 36 to 47 inches.....	.2	1.8	2.4	28.4	53.0	12.4	1.9

COLOMA SANDY LOAM.

The Coloma sandy loam is not extensively developed in St. Joseph County, the survey showing only a few hundred acres in all, located north and slightly east of Klinger Lake. In the virgin condition there is only a thin veneer of forest mold, under which there is a shallow layer of gray to slightly brownish-gray light sandy loam. This extends downward 2 to 5 inches, and then gradually changes to a grayish-yellow layer of similar texture. From a depth of about 12 inches the subsoil is a pale-yellow sandy loam. Similar material extends downward at least 8 feet. Occasionally, however, there are brownish ironlike layers, one-half inch or less in thickness, distributed at intervals of about 2 feet apart in the vertical plane. The material is relatively free from bowlders and quite different from the calcareous till underlying the Bellefontaine soils. The brownish-colored bands in the subsoil appear to have been produced by matter leached downward from the surface layers, and redeposited when the concentration of the soil solution increased. These layers seldom occur nearer than 5 feet from the surface.

The surface soil when cultivated is somewhat unstable, drifts of sand being noticeable along fences and in ditches. The topography is rolling, and the natural drainage is excessive, so that everywhere, except in the depressions, the soil is droughty. The soil, in some places, still supports a virgin forest of oak, ash, and some beech and maple. The crops are rye, buckwheat, corn, and timothy. The corn crop is not usually very large, yields of 15 to 40 bushels per acre being obtained. Rye produces 10 to 15 bushels per acre and buckwheat about the same. Timothy and redtop mixtures are grown for hay, although some farmers depend largely on marsh hay. Millet also is grown for forage.

This soil is one of the poorer types of the county, and sells for $50 to $80 an acre. Lime and organic matter with complete fertilizer applications on certain grain crops would tend to bring this soil back to a better state of productiveness. Short rotations, the growing of legumes, and the turning under of legumes as green manure, would be the best procedure in handling this soil.

FOX SANDY LOAM.

The level country around the old glacial water courses is universally waterlaid and stratified gravels and sands underlie the whole region. Where the glacial material is calcareous in origin the Fox soils are formed; and the most widely distributed type in the county is the Fox sandy loam. In its virgin state, the soil was covered with a scattered growth of oak, which gave rise to the pioneer term "oak-opening soils." In many parts of the county there are still magnificent specimens of oak forest on this soil. The accumulation of leaves and other litter in this forest is comparatively large; as much as 3 or 4 inches of such matter may overlie the virgin soil. Beneath this covering there is a layer of light reddish brown to light-brown sandy loam 4 to 7 inches thick. When first cultivated these two layers form a medium-brown, almost chestnut-brown, surface soil; under continued cropping the color fades considerably, becoming a grayish brown. The subsurface layer, lighter in color—a yellowish red or yellowish brown—and slightly heavier in texture than the surface layer, extends downward to a depth of 10 to 12 inches, gradually changing in color and texture until the third layer or subsoil is fully developed. This consists of a bright reddish brown soil, interspersed with small whitish particles, probably of chert. The layer is distinguished from those above it by its distinct reddish cast and its heavier texture, being a loam or clay loam. The lower limit of this horizon is irreglar, lying from 2½ to 5 feet below the surface. The change from this to the underlying stratum, consisting of stratified deposits of sand and gravel, porous, very calcareous, and light gray in color, is very abrupt. In places there is enough lime present to cement the gravel particles into a sort of conglomerate rock.

The drainage in places is excessive, but the heavy subsoil layer tends to hold a supply of water sufficient to tide crops over short periods of drought. The topography is favorable to cultivation, and the type is largely improved. (Pl. III, Fig. 1.)

This soil was originally a producer of grain, especially wheat, but it has generally become rather acid and will not at present support an intensive grain-farming system. Rye, corn, oats, wheat, potatoes,

and hay are the main crops. These are handled in the usual way, being grown in rotation. Most of the corn is used as silage or husked and used in fattening hogs or as feed for other stock; some finds its way to market. Oats and hay are grown almost entirely for feed, while potatoes and wheat or rye are mainly cash crops. Rye is now grown more than wheat. The crop yields vary greatly, corn producing from 35 to 70 bushels per acre, oats 30 to 65 bushels, wheat from 12 to 20 bushels, rye from 10 to 25 bushels, potatoes from 100 to 125 bushels, and hay about 1 ton per acre. Lime is necessary to obtain a stand of clover or alfalfa on the older cultivated fields of this type. (Pl. III, Fig. 2.) Acid phosphate as well as barnyard manure give good results. This soil is badly worn by cropping on most farms and requires careful attention. The land sells for $75 to $130 an acre, depending upon its present condition and location with regard to good roads and markets.

FOX LOAM.

This type is quite similar to the Fox sandy loam already described and is of only minor importance, occurring in but one area, lying north of Constantine. The surface soil is a trifle darker than that of the sandy loam type and, of course, is appreciably heavier in texture. The bright reddish-brown subsoil layer has more intense color in the loam type. Otherwise, the characteristics are the same as for the sandy loam. Slightly higher yields are obtained on the loam, and the need of fertilizer and barnyard manure is not so great. Liming for the production of clover seems to be necessary. This land is held at $125 to $150 an acre.

PLAINFIELD LOAMY SAND.

There are but two areas of the Plainfield loamy sand in the county, one situated south and east of Mottville and a smaller one bordering Klinger Lake. This type is essentially the same as the sandy loam, except that the surface material is a loamy sand and gradually changes downward into a medium or fine sand. The surface soil is poorly supplied with organic matter and extremely acid. Along the fences and hedge rows are drifts of sand, sometimes partly burying the fence. Little clover apparently is grown, the crops including only rye, potatoes, some corn, and redtop or millet. Many of the farmers depend upon marsh grasses for hay. The corn produced is mediocre in yield and quality and the crop is successful only in wet years. Potatoes do well, considering the nature of the soil, producing from 50 to 90 bushels per acre. Rye usually matures well, but the yield of grain is low. Millet is a short-season forage crop sometimes used successfully.

The proper use of this land is a problem; one solution would be a rotation of potatoes, rye, and alfalfa, plowing under an alfalfa sod every few years, and applying a complete fertilizer or barnyard manure reenforced with acid phosphate to the rye crop. Liming with marl or limestone would be essential. Even with these careful methods there would be some unprofitable years on account of the droughtiness of the soil. In its present condition the land is worth about $50 to $60 an acre improved.

PLAINFIELD SANDY LOAM.

The soil profile of the Plainfield sandy loam in its virgin state may be described as follows: On top is a shallow layer of forest mold as a rule not more than 1½ inches thick, under which appears a dull yellowish-brown layer of soil roughly 6 inches in depth. This soil is a light sandy loam in texture and seldom shows evidence of granulation or grouping of particles. In cultivated fields it is a dull yellowish-brown throughout the upper 6 inches. The subsurface or upper subsoil layer is a light yellowish brown, almost amber colored, layer of about the same texture as the surface, although in places somewhat lighter. Below a depth of 20 to 24 inches a third layer, of light brownish-yellow color, begins, and this extends without change of color or texture to a depth of more than 6 feet. Here and there some stratification is present below the 6-foot level.

This is an extensive type in St. Joseph County. It is level to slightly undulating in topography and has rather excessive drainage, on account of the open texture of the soil material and the substratum to great depth. It occurs for the most part in large areas back from the present stream courses.

Potatoes, corn, rye, oats, and grass are the prevailing crops on this soil. Where the land is in a fair state of cultivation potatoes are grown successfully, yielding from 90 to 125 bushels per acre. Corn does not always produce well, because of a lack of moisture in some years. It averages from 30 to 75 bushels of shell corn per acre in good years. Oats, which are grown for home use, yield from 30 to 35 bushels per acre. Rye does well, maturing before the summer droughts occur. Yields of 15 to 30 bushels per acre are reported. Timothy, redtop, and millet are employed as forage crops on this soil, although clover and alfalfa will grow when the soil is properly limed. (Pl. IV, Fig. 1.) Some berries are grown and market gardening is carried on successfully, the soil favoring earliness and responding readily to fertilization.

Growing more of the legumes would improve the farming conditions markedly. Fertilizers are not used extensively in general farming. Barnyard manure, however, is applied to the extent available, with good results. Farming on this soil will be found more profitable where short rotations are followed, and green manures employed to build up a sufficient supply of organic matter. In its present condition it is suffering from improper cropping systems, though it supports some of the best improvements in the county. It sells for $75 to $100 per acre, depending upon location, condition of the land, and character of the improvements.

WAUKESHA SANDY LOAM.

The Waukesha sandy loam, known locally as prairie soil, is believed to have been developed from the same material as the Fox soils, as the unweathered calcareous gravel underlying it is almost identical in color and stratification with those below the Fox. The Waukesha in its native state supported a luxuriant growth of grasses, while the true Fox soils were forested. This accounts for the greater accumulation of organic matter in the former, and for the black or chocolate-brown color of the surface soil. Subsequent leaching

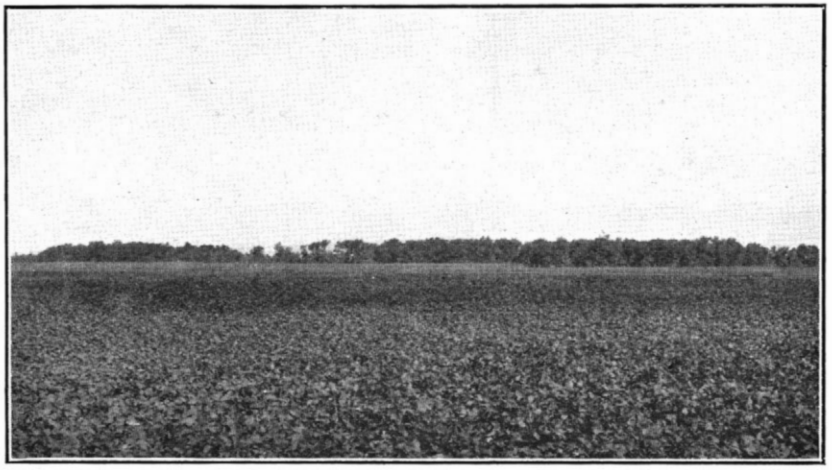

FIG. 1.—CHARACTERISTIC LEVEL TOPOGRAPHY OF THE FOX SANDY LOAM.

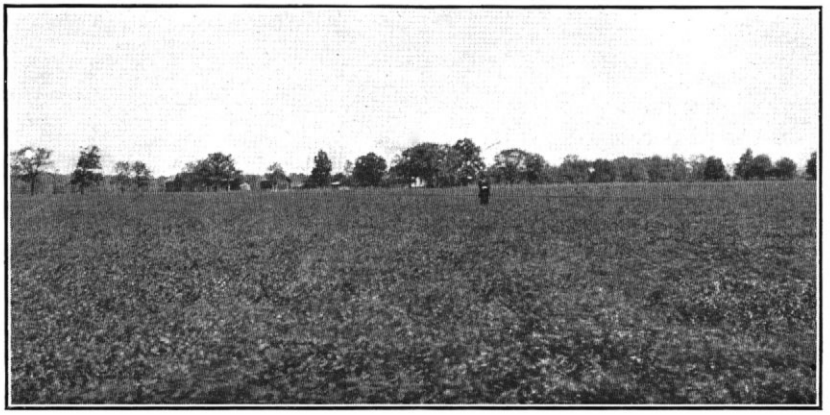

FIG. 2.—ALFALFA ON THE FOX SANDY LOAM. THIS FIELD WAS GIVEN AN APPLICATION OF GROUND LIMESTONE AT THE RATE OF 2 TONS PER ACRE.

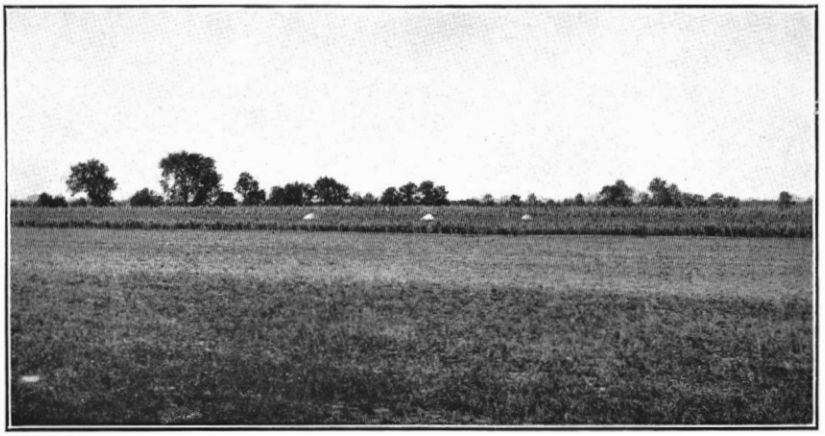

FIG. 1.—ALFALFA ON THE PLAINFIELD SANDY LOAM. A 2-TON APPLICATION OF LIMESTONE PER ACRE HAS MADE POSSIBLE THE GOOD STAND SHOWN IN THE FOREGROUND FIELD. LIMESTONE MAY BE SEEN PILED IN MILLET IN THE BACKGROUND.

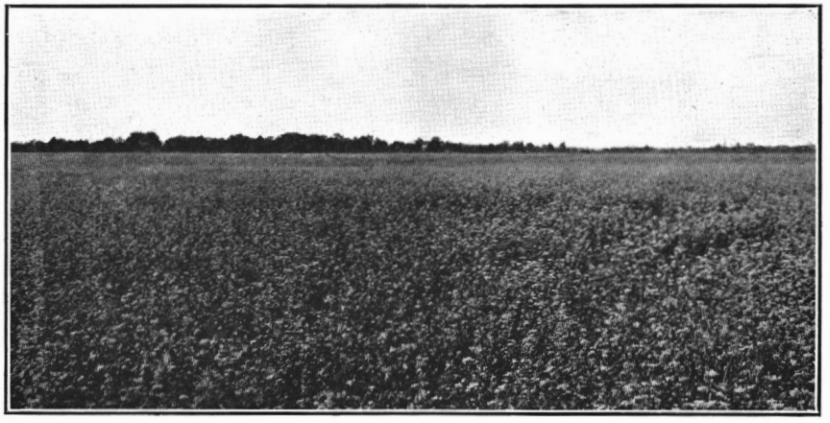

FIG. 2.—BUCKWHEAT ON THE WAUKESHA SANDY LOAM SOIL. THIS SOIL IS ONE OF THE RICHEST IN THE COUNTY.

has carried some of the black coloring matter downward and the layers below the surface are somewhat darker than similar layers in the profiles of the originally forest covered soils.

The typical profile of this soil is as follows: The first 8 or 10 inches of the soil, which is a sandy loam black to chocolate brown in color, is high in organic matter and shows a marked granular structure. An upper subsoil layer extends from a depth of 8 or 10 inches to 18 inches. This is dull brown in color, but does not differ appreciably in texture or structure from the surface layer. A third layer, the lower subsoil, is of a light ocher color and somewhat heavier in texture than the two upper layers. It crumbles easily into small granules, about the size of coffee grounds. There are occasionally faint touches of red in this layer. The substratum, occurring at a depth of 2½ to 5 feet, is a gray to yellowish-gray mass of calcareous gravel which is stratified, generally coarse, and very porous. In places the stratified gravel beds lie at depths greater than 6 feet, their place being taken by a yellowish-gray sand. When the gravel beds lie more than 4 feet below the surface, the soil does not seem to be very droughty, but when they are within 3 feet of the surface crops often suffer for water in dry seasons. The beds show this variation in depth within each of the various prairies. In the small area along the boundary line, near Flowerfield, the texture is more nearly a loam than a silt loam.

There are four large areas of this soil and three small ones, their total area being 5.5 per cent of the area of the county. It is the most desirable soil from the standpoint of productiveness, drainage conditions, and general workability in the county. Many different crops are grown. The most common rotation is corn, oats, wheat, and hay. Some corn is "hogged off" and some is used to fill silos, but the greater part of the crop is husked by hand or with a shredder and husker. Oats are grown mostly for feed; wheat and rye are almost entirely cash crops. Buckwheat is among the crops grown on this soil. (Pl. IV, Fig. 2.) Alfalfa and clover only grow well on this soil when lime is applied, but timothy will produce good yields without it. Barnyard manure has a very marked effect on plant growth, which would not be expected on a soil with so high a content of organic matter. The natural organic matter seems to be inactive, however, and fresh applications as manure show good effects. Nitrate of soda also is beneficial. Lime is a necessity in growing the legumes and seems also to affect other crops favorably.

This type, which is highly developed and improved, sells for $100 to $150 an acre, small areas being priced somewhat higher.

MAUMEE SANDY LOAM.

The Maumee sandy loam is a soil of small extent, occupying poorly drained areas in depressions along small spring-fed streams or lying in valleys that are wet during a part of the year. The moist conditions under which the soil exists stimulates a rank growth of vegetation and favors the accumulation of organic matter, making the surface soil very dark gray or black. The texture is variable; it may range from a loamy sand to a loam in any one area, and an average textural name was employed to avoid unnecessary detail in mapping a soil of such little importance. Below the black layer and beginning

at a depth of 8 or 11 inches is a grayish-yellow layer, about 10 inches thick, marked with scattered spots and streaks of brown or yellow. The next layer is highly mottled, showing drab, yellow, brown, blue, and red colors, of approximately equal distribution. The transition between these two layers is gradual, there being an increase in the amount of mottling to a depth of about 2½ and 3 feet, where a uniform bluish-gray layer of stratified calcareous sand and clay is encountered. This substratum is appreciably heavier in texture than the overlying strata, and seems to be in a saturated condition almost continuously.

The topography of the Maumee sandy loam is level and the drainage poor. The forest growth consisted of elm, swamp oak, and other moisture-loving trees, such as willow and poplar. The type is not important from the standpoint of general farming, but is used for grazing and the production of hay. In dry seasons corn and small grains will do well on this soil, as it is relatively fertile, and when it can be drained the results are well worth the expense.

It is difficult to determine the value of this soil as it occurs only in small areas and is sold with other land. Undrained areas would not bring more than $60 an acre.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Maumee sandy loam:

Mechanical anaylses of Maumee sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
301526..	Soil, 1 to 8 inches.....	1.3	8.3	12.1	39.5	10.5	22.4	5.8
301527..	Subsurface, 8 to 14 inches.....	2.0	17.5	19.2	36.1	5.3	12.0	8.1
301528..	Subsoil, 15 to 36 inches	1.1	9.3	16.0	53.7	9.3	6.9	3.9

NEWTON SANDY LOAM.

Like the Maumee sandy loam, the Newton sandy loam is developed under moist conditions, but where drainage is somewhat less deficient. The surface soil is a sandy loam of a dull-drab or dark-gray color, and about 7 inches deep. Below this is a slightly lighter gray layer, in which a few scattered spots or streaks of brown or pale yellow occur. This layer gradually changes to a highly mottled dull-drab subsoil, which extends from about 15 inches to 4 or 5 feet, the level of ground water. The material forming the substratum is of a uniform, blue-gray color, noncalcareous, and in many places definitely stratified. The subsoil and substratum are somewhat more compact and of heavier texture than the soil and subsurface layers. The structure is open and porous only in the surface soil.

Although the Newton sandy loam is generally developed under lake conditions, there are some apparently typical areas in St. Joseph County that lie along small intermittent streams. It is probable that the areas which these streams drain were formerly lakes. There are also variations in texture in this type as mapped, because of the evident impracticability of mapping a few small areas of another class. The agricultural importance of this soil is small. The pro-

duction of hay and grazing are the best uses to which it can be put. The natural fertility is good, and corn, cereals, and potatoes will do well on properly drained areas. The value of land of this type is indefinite, but is probably about the same as that of Maumee sandy loam—$60 or less an acre.

The following table gives the results of mechanical analyses of samples of soil, subsurface, and subsoil of the Newton sandy loam:

Mechanical analyses of Newton sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
301539..	Soil, 1 to 7 inches.....	0.5	7.1	17.1	43.4	7.5	19.6	4.9
301540..	Subsurface, 7 to 15 inches.....	.3	7.0	14.7	46.4	8.9	17.4	5.1
301541..	Subsoil, 15 to 40 inches	.6	8.1	19.4	50.9	7.3	9.6	4.0

GENESEE LOAM.

The soil of the Genesee loam is a chestnut-brown loam, about 12 inches deep, gradually becoming darker and showing slight mottling at depths of 2½ to 3 feet. The mottling is lighter than the base color, sometimes yellow or reddish yellow. The subsoil in many places is stratified, of variable texture, and of granular structure. Material similar to this subsoil layer extends to a depth of at least 5 feet with little change. This soil does not show the zonation found in the upland soils, for the reason that it is still in its youth and sufficient time has not elapsed for the development of distinct layers since deposition of the material. Both soil and subsoil are stratified and the structure is granular throughout. The material is supposed to have been derived from calcareous drift, but does not effervesce with hydrochloric acid. The topography in general is level, but in detail hummocky.

This type is developed only along the St. Joseph River, and does not form all of the flood plain of this stream. Thus its total area is small, which fact, when coupled with the position it occupies, makes it of little agricultural importance. The soil is inundated yearly, and is not suited to the production of fall-sown crops, though it is naturally productive. It is used as pasture land and for the production of corn and hay.

When fairly well drained it ordinarily has a value of $80 an acre, the price depending somewhat upon its extent in any one place; the larger areas are worth relatively more for farming than small areas.

WABASH LOAM.

Where the drainage of the river flood plains is very poor, so that during a large part of the year the soil is under water or has a high water table, the resulting surface soil is black or brownish black in color. This is the condition under which the Wabash soils are developed. Below the black-colored surface soil, which extends downward about 8 to 10 inches, is a dull, dark-brownish layer of soil, mottled with lighter brown and red streaks and spots. This extends downward at least 4 feet, gradually passing into a dull-grayish sand or clay.

Elm, some poplar, and willow grow naturally on this soil. It is quite level and used mainly for pasture or for the production of hay. It presents a marshy appearance and is very undesirable as a crop-producing soil. Its value is less than $50 an acre. The soil forms less than 1 per cent of the total area of the county.

MUCK.

The Muck in this area is in general deep, although there may be a few small bodies in which the depth would not exceed 3 feet in any place. The usual condition is a shallow formation for about 100 feet from the border with a deep deposit over the greater part of any given area. The material from which these deposits have been formed is quite variable. It would seem that the Muck formed in the river flood plains would not be quite the same as that formed under lake conditions. Superficial studies in the field upon these two kinds of Muck did not reveal any striking differences, however. No area of sphagnum peat was encountered in the county.

Drainage is the most important factor in the development of the soil profile of Muck. Where drainage is deficient there is little difference in the decay throughout the mass. Where drainage is good, and the greater part of the year the water table is 2 or 3 feet below the surface, there begin to develop distinct layers in which the decomposition of the fibrous mass in the surface has entirely obliterated the original forms to a depth of perhaps 8 or 10 inches, a little less decay in the next layer, and only a partial breaking down of the fibers, so that both fibrous and nonfibrous material are present, and finally a third more moist layer in which scarcely any change in the vegetable remains has taken place. It must be understood that these changes are not abrupt, and that the decomposition decreases gradually with depth, until the level of ground water is reached. Underlying the mass of organic matter is a silty sand or silty clay, quite impervious to water and of a bluish gray color. In places the underlying deposit consists of marl. When of a good quality this is valuable for correcting the acidity of the upland soils.

Muck is widely distributed over the county, but occurs commonly in such small areas that only a little of it has been drained and otherwise reclaimed for use as farm lands. One area north of Klinger Lake, locally known as the Woodward Marsh, has been highly developed and is a very good soil for a variety of crops, with proper fertilization. Peppermint is grown as a specialty on this tract and another area lying north and east of Mendon also is devoted largely to this crop.

The undrained soil is used for pasture or the production of marsh hay, and consequently its value is low. Drained Muck is worth as much as the surrounding upland soils for the production of crops not too sensitive to frosts. There are great possibilities in this soil where thorough drainage can be supplied.

SUMMARY.

St. Joseph County lies along the southern boundary of Michigan in the watershed of the St. Joseph River. The area is 503 square miles or 321,920 acres. The average elevation of the county is about

848 feet, and the range in elevation is from 760 feet to over 1,000 feet above sea level. The most striking physiographic feature of the county consists of the outwash plains. The area of drift unmodified by reworking the moraines is not extensive.

The county was first settled in 1813, but not until 1830 did many settlers come in. The population of the county in 1920 was 26,818. Two cities, Sturgis and Three Rivers, have more than 5,000 population. These and other towns in the area afford shipping points or ready markets for the products of the county.

The climate is comparatively mild, with a relatively long growing season. There is an average annual precipitation of 38.49 inches, well distributed through the year. The normal snowfull is 41 inches. Twenty-two degrees below zero is the absolute minimum and 100° F. the absolute maximum temperature. The mean annual temperature is 47.8° F.

Agriculture dates from about 1825, when the first settlers began to farm the prairie lands. Soon thereafter the level plains were settled and some years later the rougher ridge-land soils were brought under cultivation. In 1900 about 94 per cent of the area of the county was in farms. From 1870 to 1900 the county was a great grain producing center. Rye is now the principal small grain crop. The acreage in corn is slightly greater than that in rye. Clover has become a minor crop on account of the acidity of the soils. A mixed type of farming is practiced at present, with more stock raising and a greater diversity of crops than formerly. Fertilizers are used by only 478 of the total of 2,436 farms in the county. The use of acid phosphate and lime is becoming more general each year.

The average size of the farms in the county is 119.9 acres, of which 96 acres is improved land. The average value of the property on each farm is $10,692. About two-thirds of the farms are operated by the owners and about one-third by tenants and managers.

The soils of the county are derived entirely from glacial material which in some cases was left in rough, hilly areas of unassorted drift, and in other places in widespread outwash plains, of assorted materials. The drift averages about 300 feet in depth and is correlated with the late Wisconsin. Limestone is the chief constitutent of the drift; sandstone and other rocks have contributed a part of the materials. The texture of the derived soils is uniformly light, loam being the heaviest class mapped in the county.

The rolling to hilly, morainic areas are occupied by soils of the Coloma, Rodman, and Bellefontaine series, and the level to gently undulating areas in the northeastern part of the county by the Conover and Crosby series.

The Crosby series is the most deficient in drainage and it and the Conover are the only soils occurring in the uplands that have a streaked or mottled subsoil. One type of this series, the loam, is developed in the county. The Conover loam is one of the best soils in the county. The Crosby loam is of minor importance.

The Coloma series is represented by one type, the Coloma sandy loam. It is of rather low productiveness and deficient in power to hold water. The surface soil is low in organic matter, and the texture of the subsoil and substratum is generally lighter than that of the soil and sufficiently porous to make the land somewhat droughty.

The Rodman series is represented by the sandy loam type only. It is almost nonagricultural on account of its rough topography and its light gravelly nature. It is derived mainly from stratified calcareous drift.

The Bellefontaine series is the most important of the upland group. The surface soils are fairly well supplied with organic matter, giving them a brown to dark reddish brown color, and are underlain at relatively shallow depths by materials of relatively heavy texture and good water-holding capacity. These soils are generally in a good state of productiveness throughout the county. The influence of limestone is everywhere apparent. The sandy loam type and the loam are mapped.

The soils developed upon the level outwash plains are mapped as Fox and Plainfield, where they originally supported a growth of forest, and as Waukesha, where they have developed under prairie conditions; that is, where the vegetation has consisted of grasses.

The Fox series has been derived from reworked drift coming originally from limestone, chert, gneiss, granite, sandstone, and other rocks, while the Plainfield soils are from material containing little or no limestone. The Fox sandy loam is the most extensive soil in the county, forming 33.2 per cent of the area of the county. It is underlain by a layer heavier in texture than the soil, which tends to improve the moisture conditions during dry periods.

The Plainfield soils are not underlain by a heavier-textured subsoil like that beneath the Fox soils, and are, therefore, more inclined to droughtiness. The sandy loam and loamy sand types are mapped, the latter being one of the poorer soils in the county.

The Waukesha sandy loam is mapped where a prairie condition existed in the outwash plains and levels. It is considered the richest and most desirable soil in the county. It is well drained, but withstands drought fairly well, except in spots where the underlying gravel beds occur within 2 or 3 feet of the surface.

Maumee sandy loam and Newton sandy loam are lowland soils developed under deficient drainage conditions and are usually dark in color. The former shows the presence of limestone in its unweathered layers; the latter little or none on account of the light sandy nature of the material. Agriculturally these soils are not important, because of their small extent.

The soils of the river flood plains are classed in two series—those moderately well drained and brown in color being correlated with the Genesee, and those poorly drained and almost black in color with the Wabash. The loams of these series are mapped. Both are young soils and possess no well-defined layers developed since deposition. Contributions from limestone rock have influenced their composition.

Muck occurs in small areas throughout the county, occupying depressions, former lakes in the uplands, and low areas along many of the rivers and smaller streams. When drained these areas become very productive lands, though more subject to frosts than the higher-lying well-drained soils. The larger areas of Muck could be reclaimed and used for the production of special crops.

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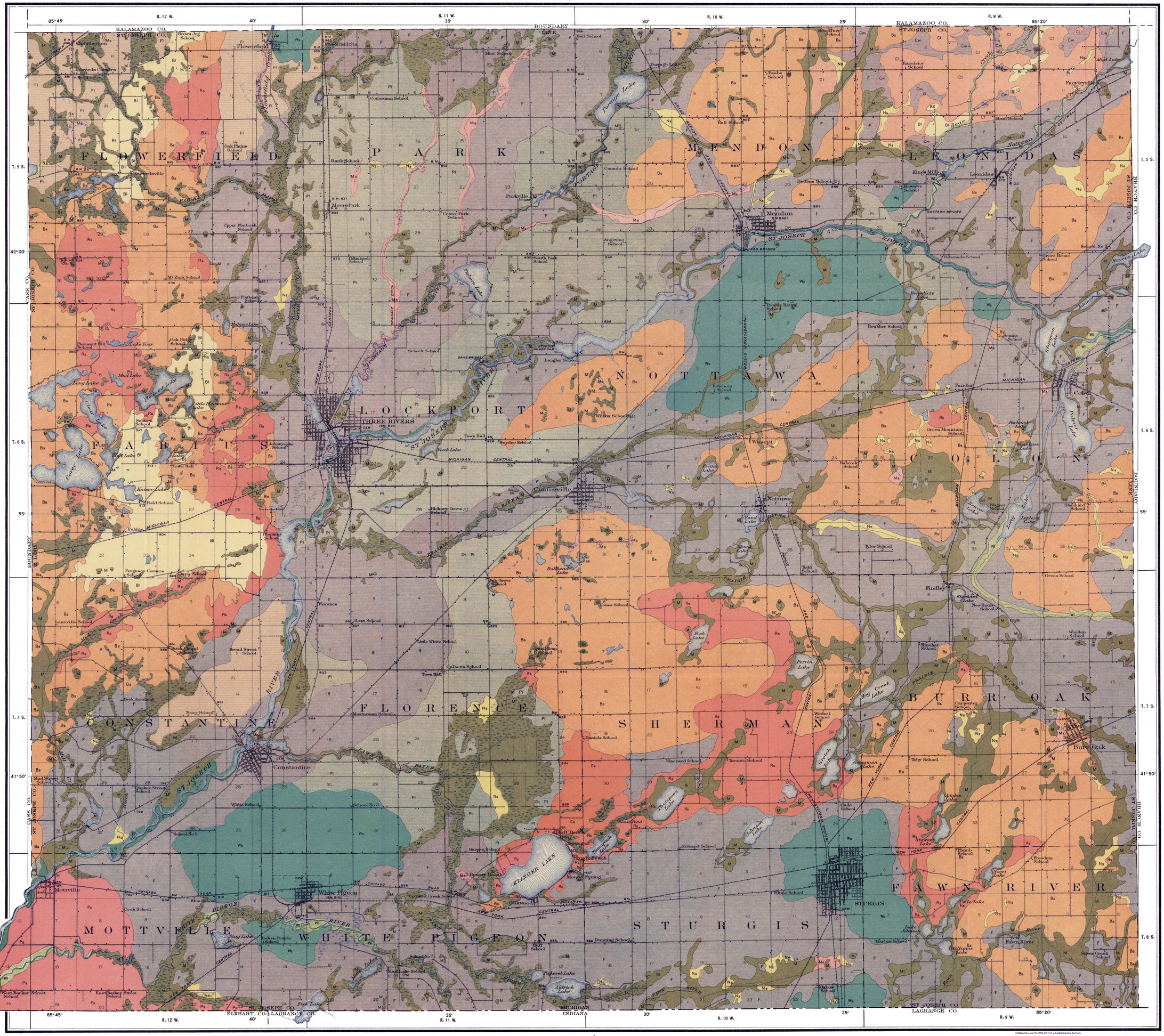
U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS
IN COOPERATION WITH THE
MICHIGAN AGRICULTURAL EXPERIMENT STATION

SOIL MAP

MICHIGAN
ST. JOSEPH COUNTY SHEET



LEGEND

Bellefontaine sandy loam — Bs	Maumee sandy loam — Ms
Bellefontaine loam — Bl	Newton sandy loam — Ns
Coloma sandy loam — Cs	Plainfield loamy sand — Ps
Conover loam — Cl	Plainfield sandy loam — Pl
Crosby loam — Cm	Rodman sandy loam — Rs
Fox sandy loam — F	Wabash loam — Wl
Fox loam — Fl	Waukesha sandy loam — Ws
Genesee loam — G	Muck — M

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
- Secondary roads and Trails
- Railroads, Steam and Electric (DOUBLE TRACK, SINGLE TRACK, INCHARGE, IN ROAD)
- Bridges, Ferry
- R.R. crossings, Tunnel (R.R. ABOVE, R.R. BELOW)
- Ford, Dam
- School or Church, Cemeteries (SCH, CEM)
- Mine or Quarry, Mine dumps, Made land
- Bluff, Escarpment, Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines (STATE, COUNTY)
- Boundary lines (LAND GRANT, CITY OR VILLAGE)
- Boundary lines (CIVIL TOWNSHIP, RESERVATION)
- U.S. township and section lines

RELIEF
(Printed in brown or black)

- Contours, Depression contours
- Prominent Hills, Mountain Peaks
- Sand, Wash, and Sand dunes
- Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Soils surveyed by L. C. Wheeting, in charge, and S. G. Bergquist of the Michigan Agricultural Experiment Station.

BASE MAP IN PART FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale 1/62500
1 0 1 2 3 Miles

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

Field Operations
Bureau of Soils
1921